Consistent Adaptation to Surface and Environmental Conditions Between Passive MW Imagers and MW Sounders

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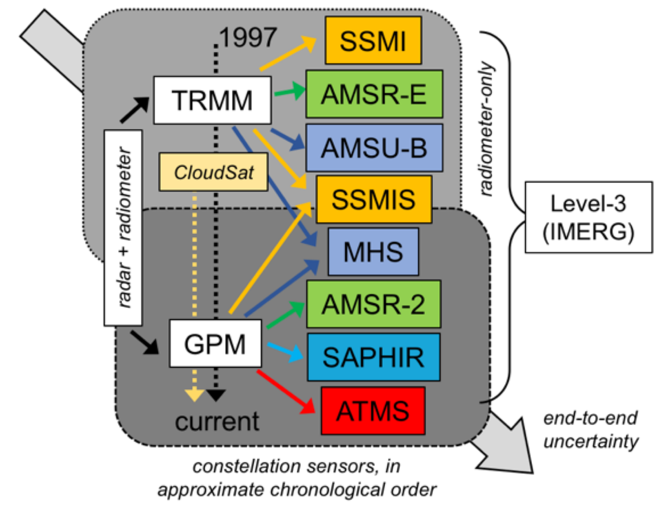
Summary

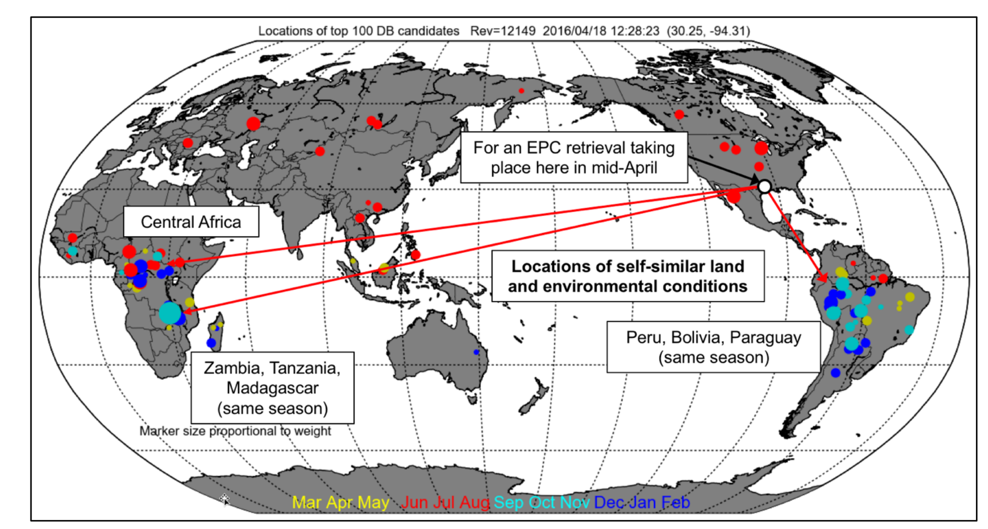
The GPM and TRMM constellations are a mixture of MW imagers and sounders, with different sampling and observing characteristics. The coverage needed to maintain a sub-3-hour revisit across mid-latitude areas is captured by the many *wide-swath MW sounders*, such as ATMS and MHS, with their variable resolution relative to MW imagers such as GMI. A desirable goal is a common method to directly transfer the Level-2 observations and products from the single GPM or TRMM radar (not only precipitation rate, but the associated *vertical structure* and *type* of precipitation) across all passive MW imagers and sounders in the TRMM+GPM era constellation. Furthermore, this method should also retain consistency with the surface and environmental characteristics at the time of each satellite overpass.



Why is this important?

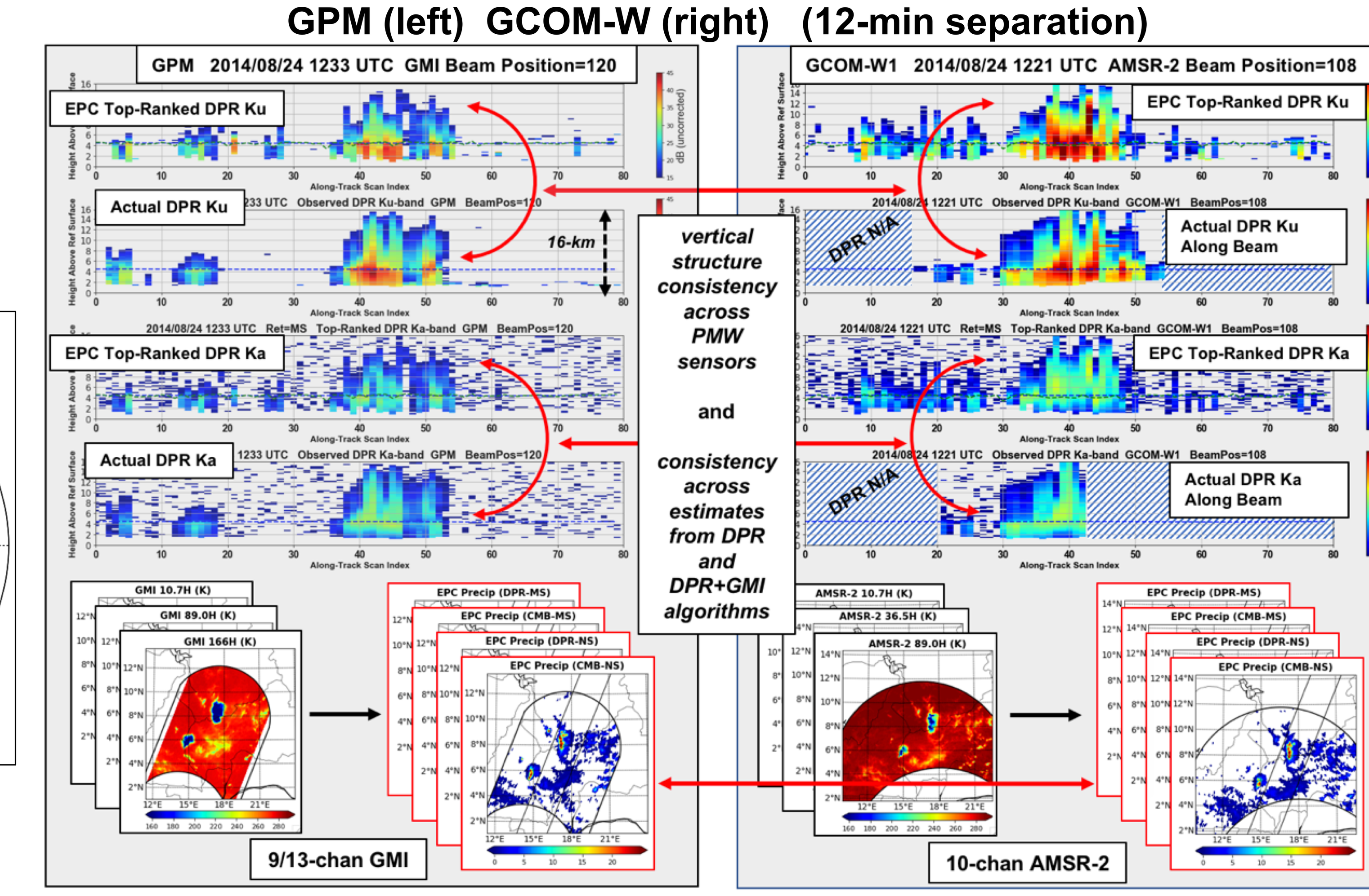
The most requested products from PPS are the gridded Level-3 products, such as IMERG. At its core, IMERG evolves the precipitation structure from satellite-1 (taken at time 1) and satellite-2 (taken at time 2). Satellites 1 and 2 can be from any of the mixture of satellites/sensors in the constellation. A common method to reference directly to the core radar products leads to a high level of consistency amongst the various radiometer-only precipitation products that eventually feed Level-3 products.

The emissivity principal components (EPC) method uses the leading PCs of the surface emissivity vector to index and link to observational *a-priori* databases. Since the EPC elements can be estimated from the radiometer TB observations, no ancillary model nor surface information is needed after the *a-priori* has been constructed (*Turk et al 2017*).

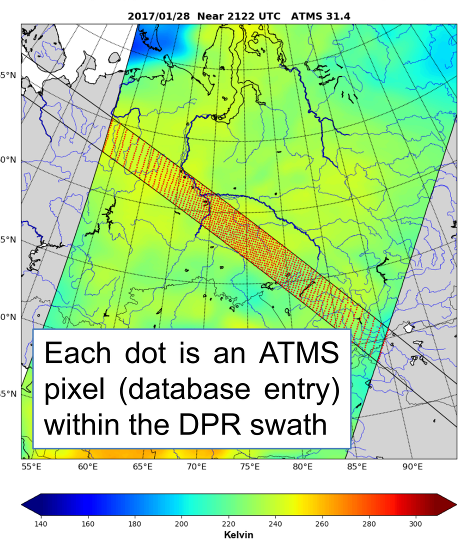


Turk F.J, Z.S. Haddad, P. Kirstetter, Y. You, S. Ringerud (2017). An observationally based method for stratifying a-priori passive microwave observations in a Bayesian-based precipitation retrieval framework. Q.J.R. Meteorol. Soc. doi:10.1002/qj.3203

GPM (left) GCOM-W (right) (12-min separation)



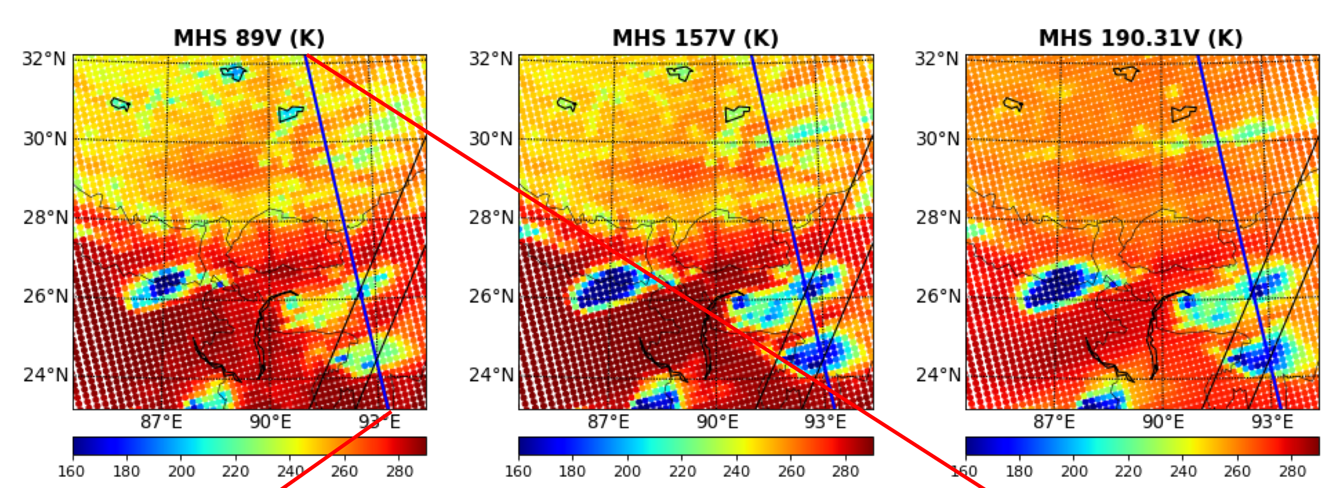
GPM-NPP (ATMS) Coincidence 01/28/2017 Near 2122 UTC

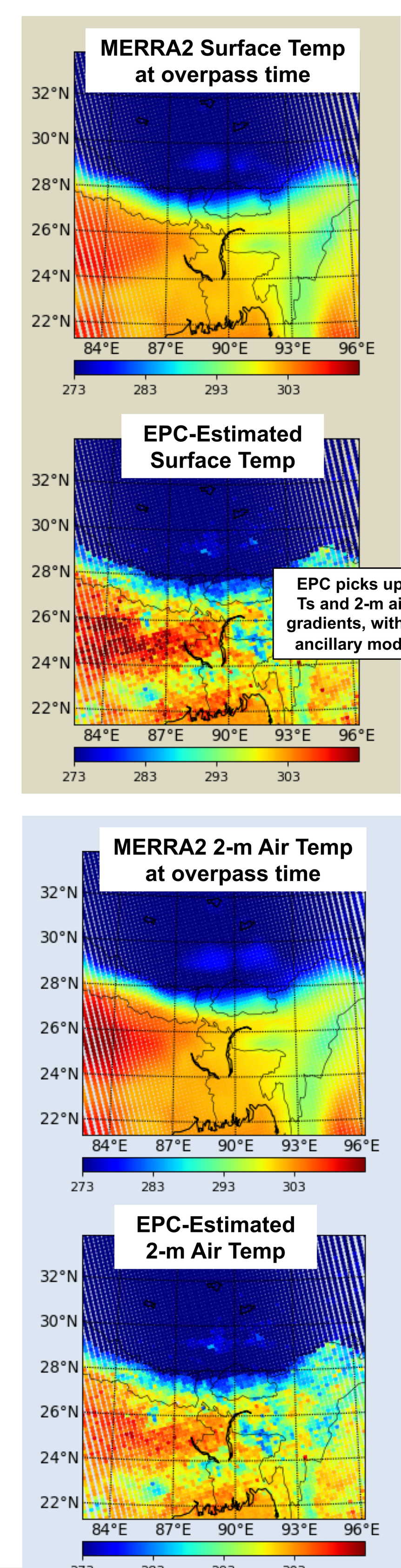


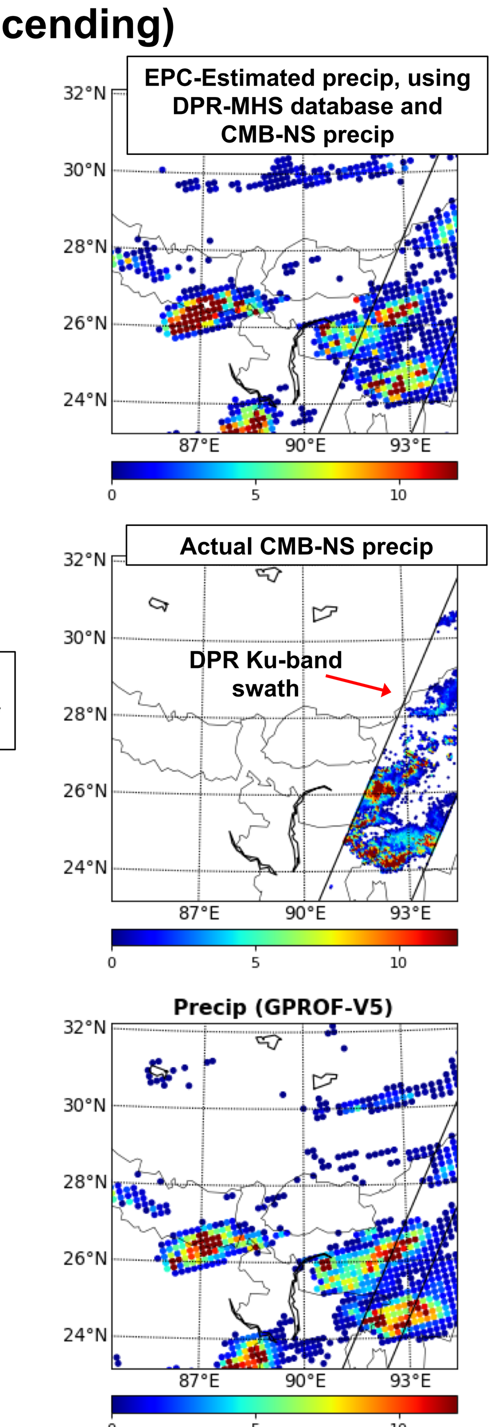
Observational *a-priori* Databases for each Sensor

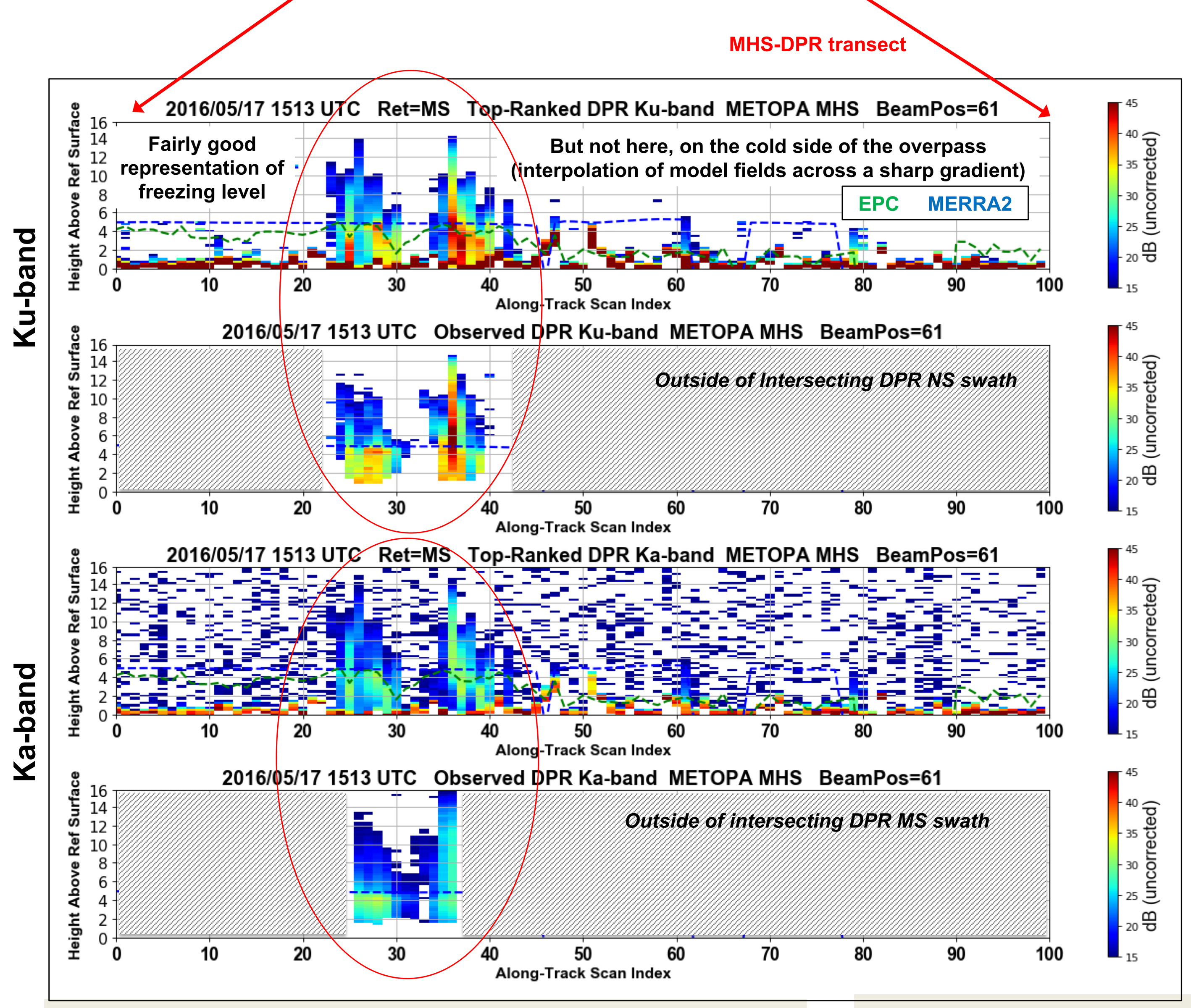
Four years (thru April 2018) of DPR Ku- and Ka-band Zmeasured profiles and precipitation rate retrievals from ±15-min coincidences between GPM and each of the constellation radiometers (GMI, SSMIS, ATMS, MHS, AMSR2, SAPHIR) are directly transferred into the databases, along with other DPR products (e.g., precipitation type classification, shallow rain flag, elevation), and ancillary environmental fields from the MERRA2 reanalysis. Four radar retrievals are added: the Ku-only (NS) and Ku/Ka (MS)-based estimates from the DPR and the combined DPR+GMI (CMB). This allows joint verification of the EPC-estimated surface precipitation *and* the DPR vertical structure profiles that were selected by the radiometer-only EPC retrieval. Since the EPC requires no ancillary data (once the *a-priori* databases have been constructed), the actual surface and environmental conditions at the time of the overpass can be compared with the top EPC-selected candidate profiles. Examples from ATMS and MHS are shown below.

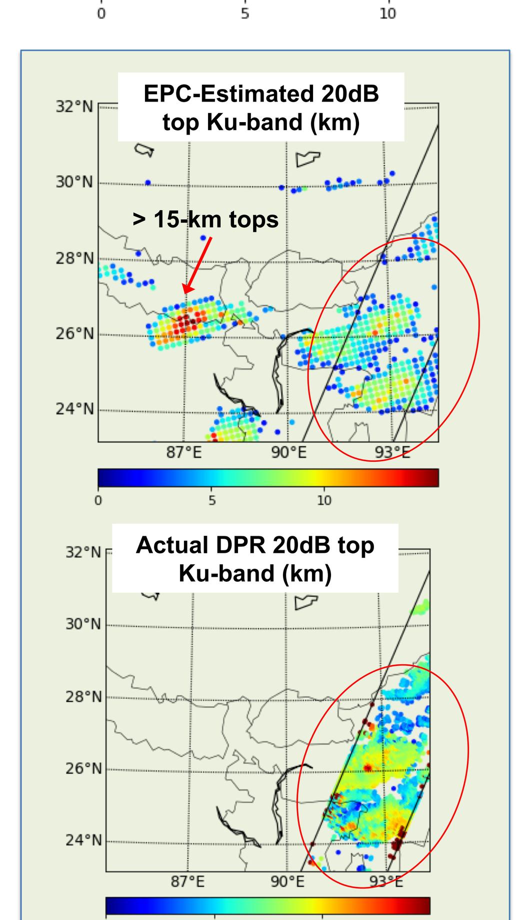
MHS METOP-A Bhutan-Tibetan Plateau (28N, 89E) 2016/05/17 1513 UTC (Ascending)

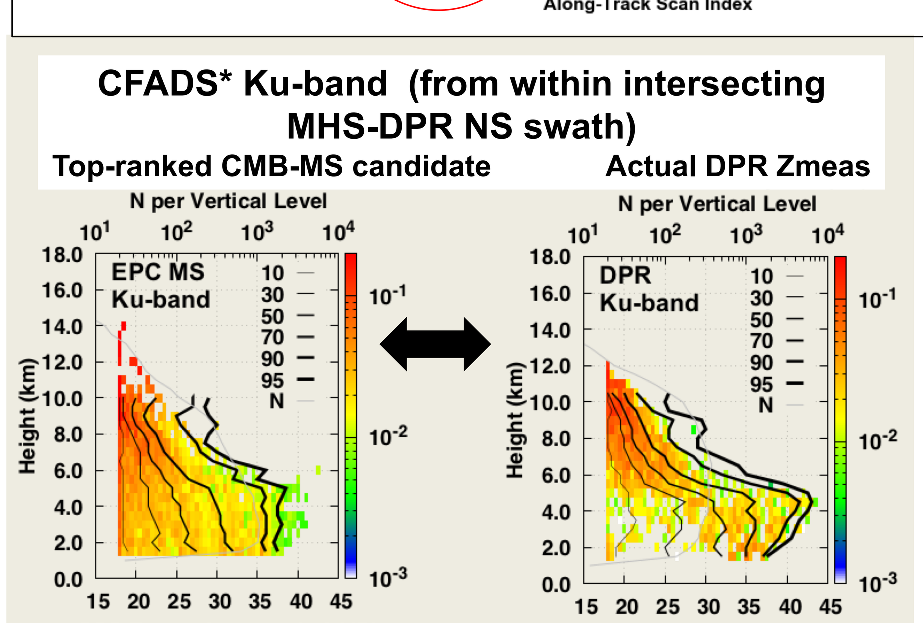


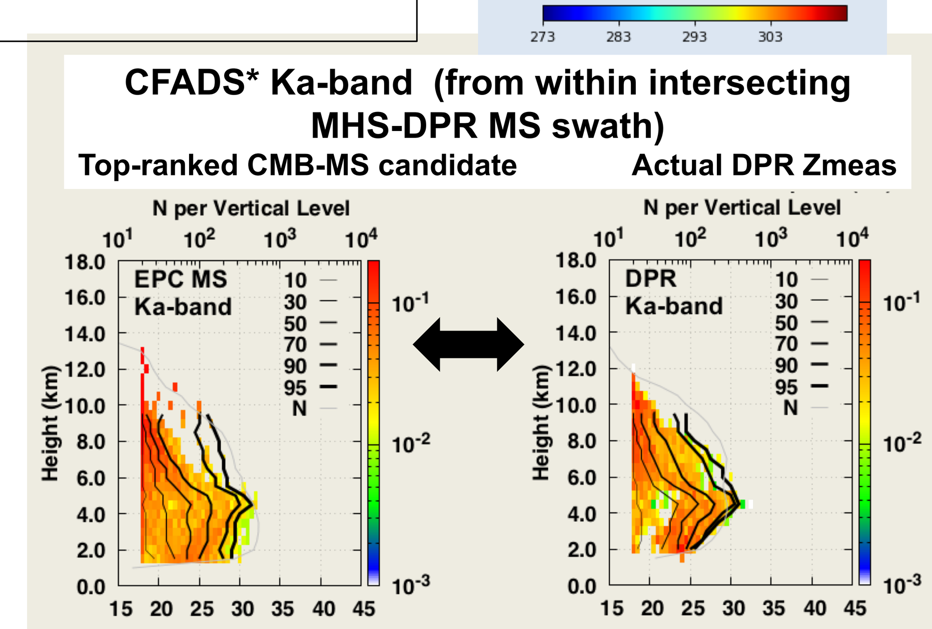






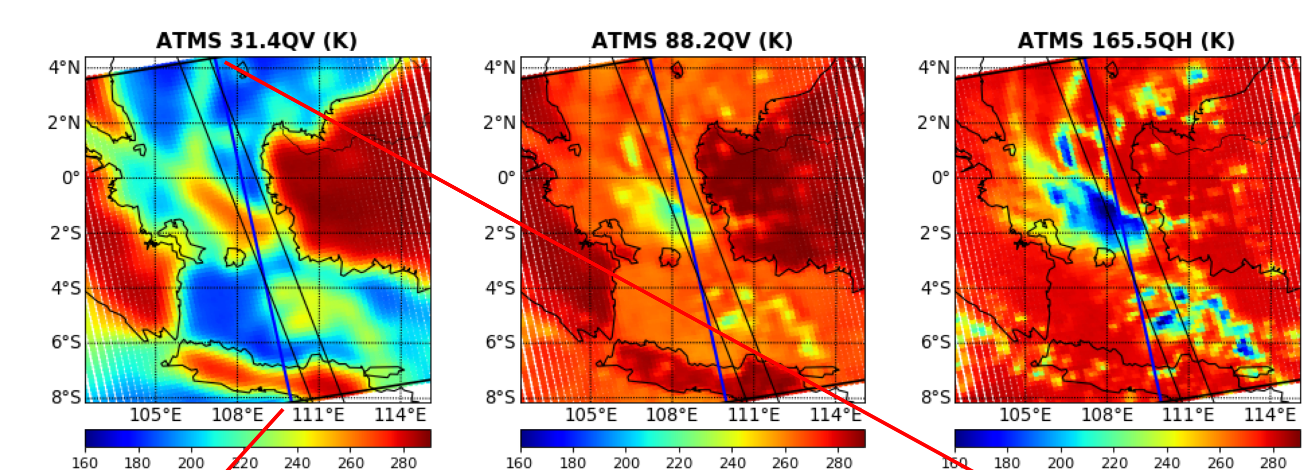


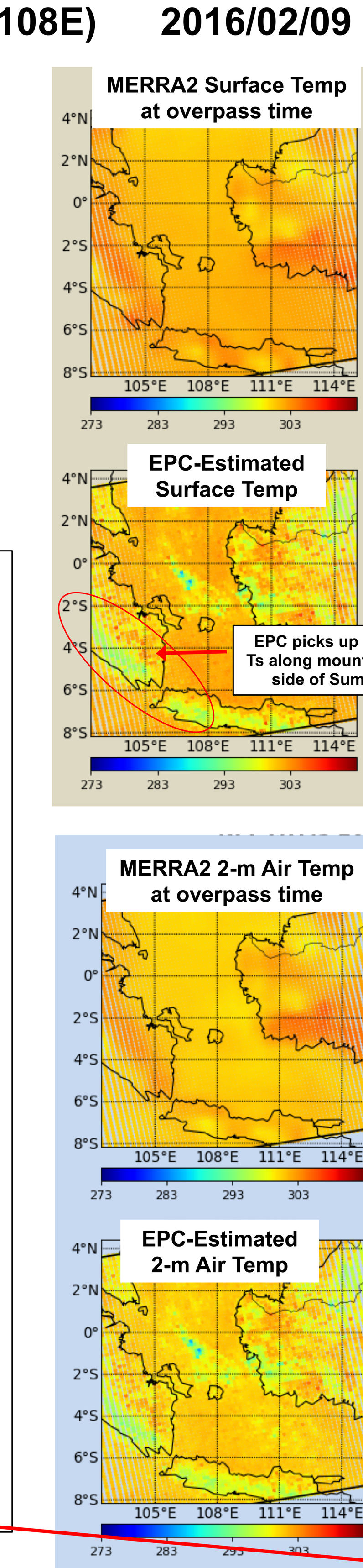


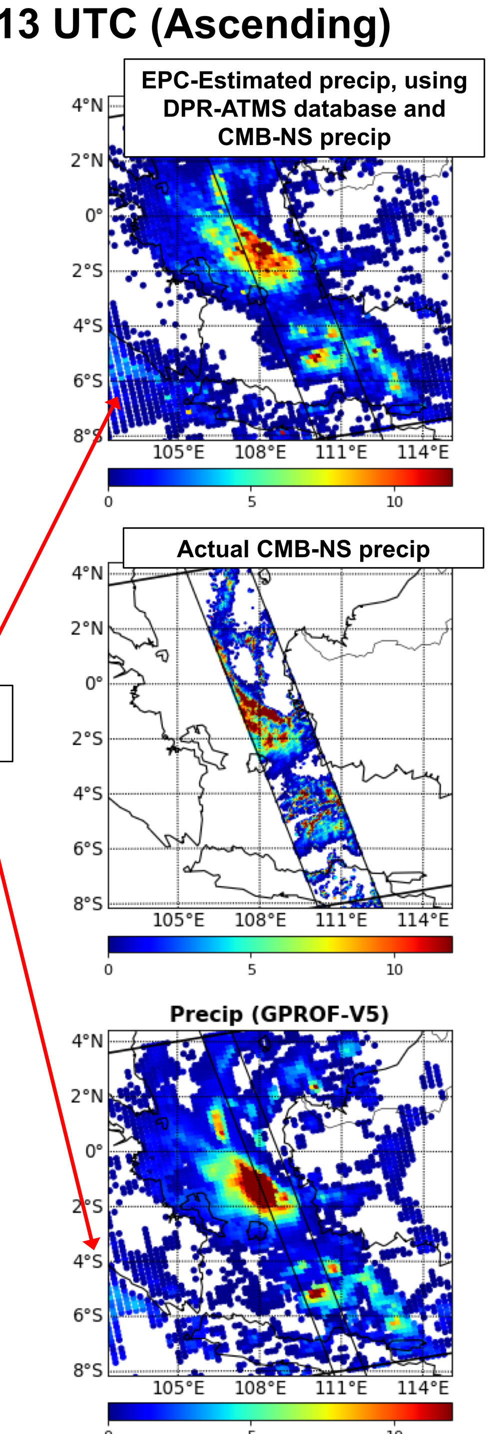


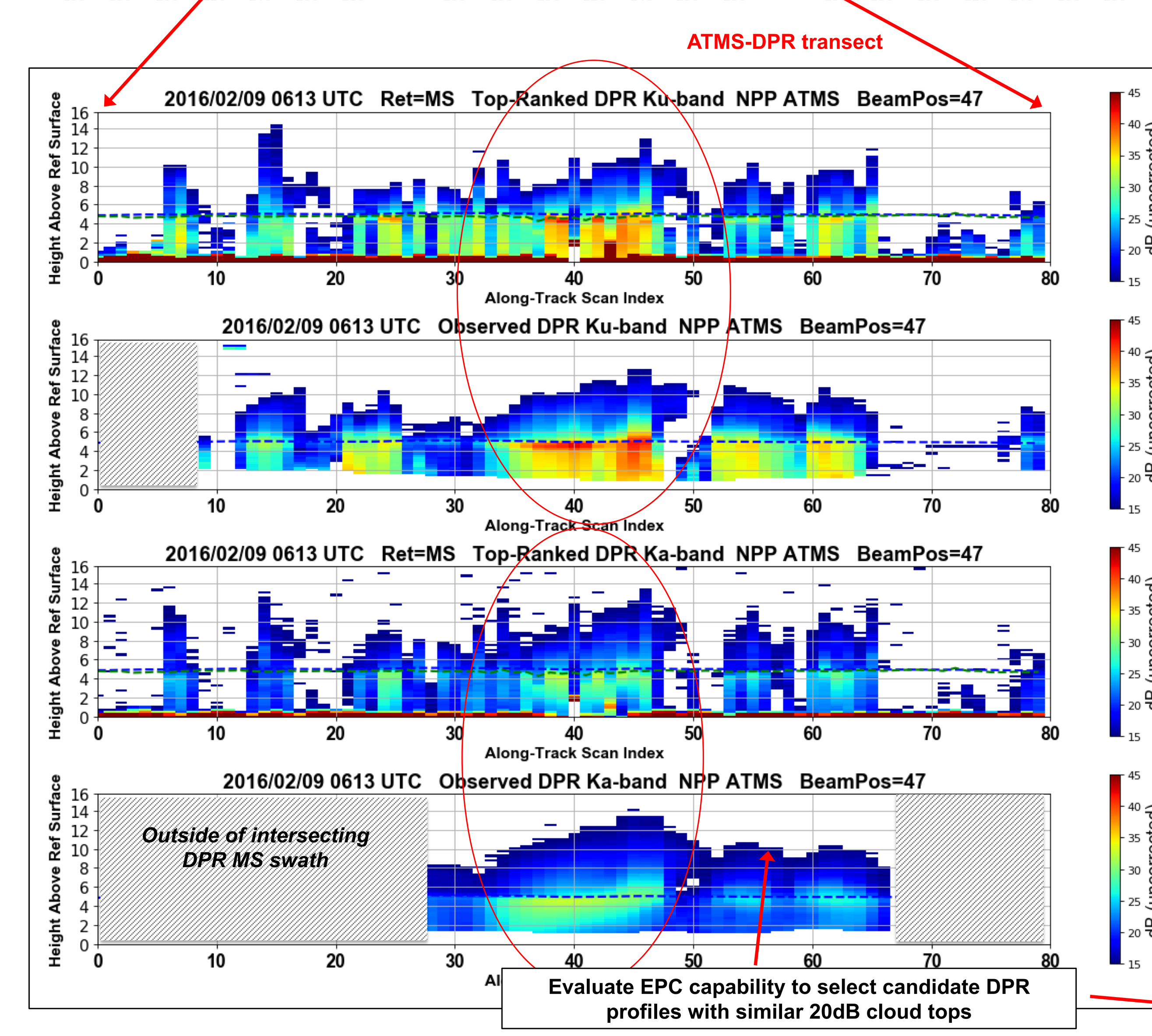
*contoured frequency by altitude diagram

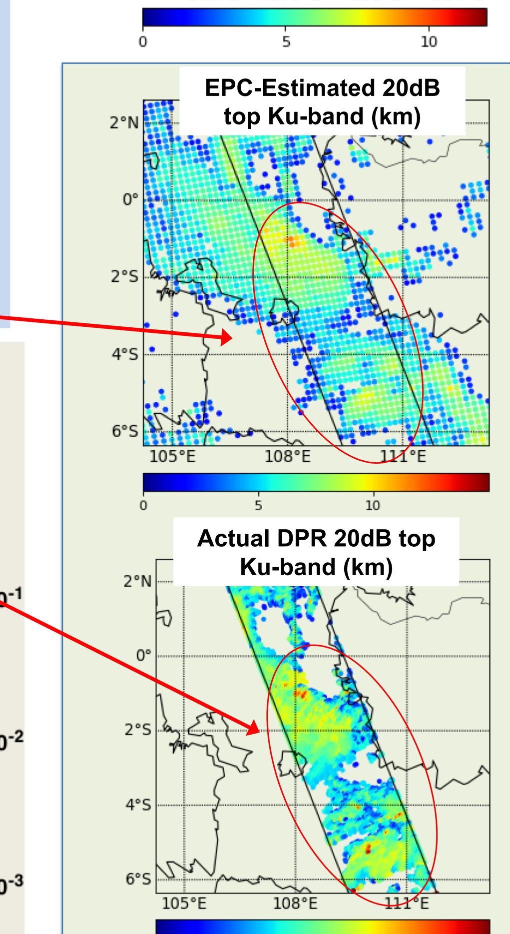
ATMS Suomi-NPP Between Kalimantan and Sumatra (2S, 108E) 2016/02/09 0613 UTC (Ascending)

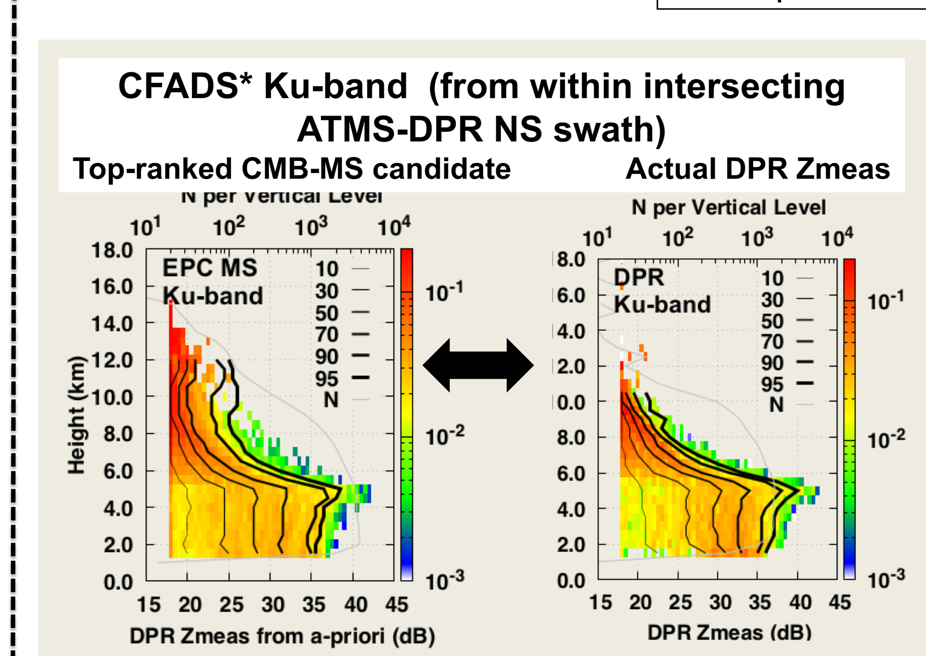


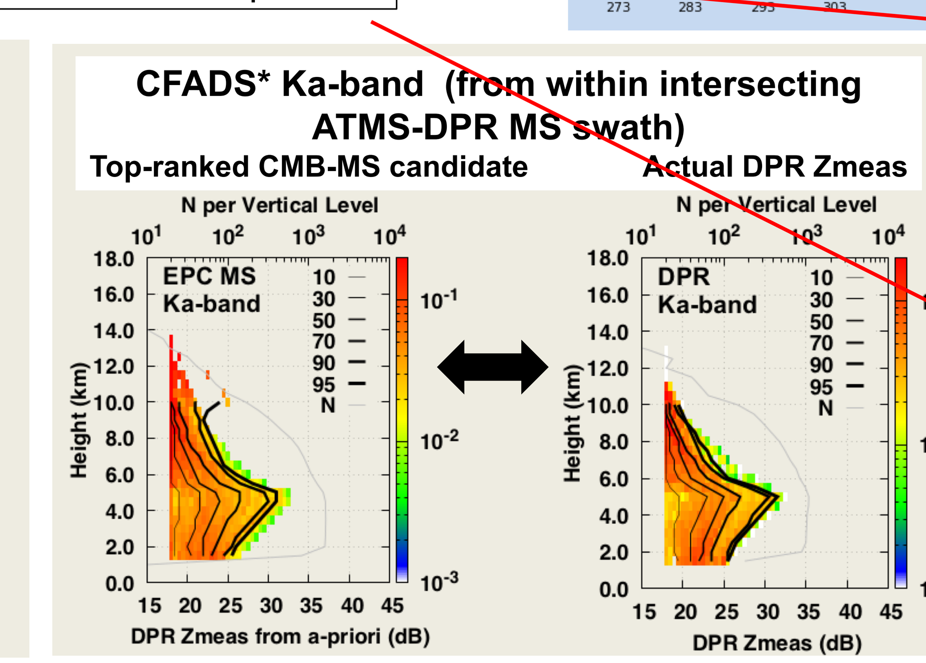












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